The Center for Applied Scientific Computing

Overcoming national security challenges through computational innovation

We solve problems

in mathematics, computer science, and data science for problems critical to national security. Addressing challenges in the weapons program, cyber and energy security, and knowledge discovery applications requires the power of high performance computers and the efficiency of modern computational methods. Our research and development activities are applications-driven and focused on LLNL's mission. CASC's core competencies include high performance computing, computational physics, numerical mathematics, computer science, and data science.

Our research is foundational

to DOE's ability to fulfill its national security mission, advance scientific discovery through basic research, and gain insight through large-scale data analytics.

Innovative research on the world's largest supercomputers

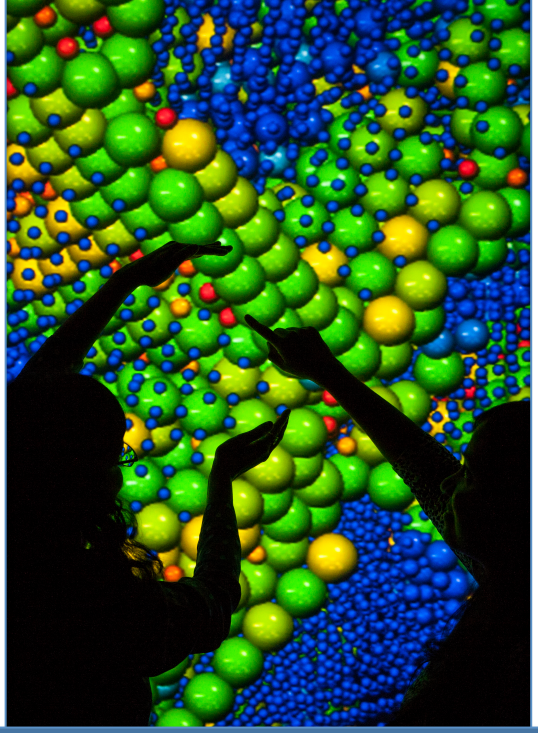
Recent examples of CASC researchers' pioneering accomplishments include:

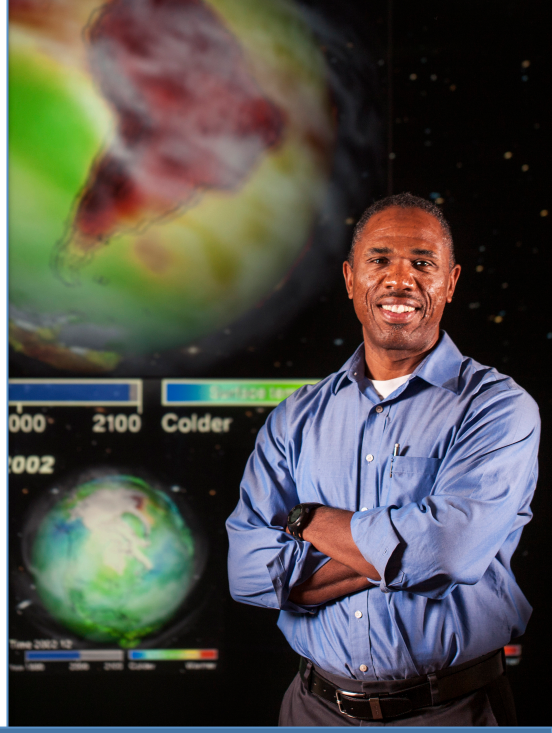
- The world's largest parallel discrete event simulation containing billions of interacting agents on millions of cores, enabling scenario evaluation on global scales
- Rethinking the methods that drive simulations, such as developing truly multi-level parallel-in-time techniques that improve time to solution by orders of magnitude
- Creating the computing tools and programming environments that will enable productive use of the next-generation of computers

A revolution in computer architecture is ahead

In 2017, LLNL will introduce a 150-petaflop computer called Sierra. The system will offer unprecedented and challenging parallelism, containing millions of heterogeneous cores. Effectively utilizing this machine, and the exascale systems that will follow, will require fully rethinking the computational mathematics, multi-scale and multi-physics methods, uncertainty quantification, and data analysis methods that are the foundation of LLNL's sophisticated scientific simulations. CASC will be among the leaders in the research that reinvents scientific computing.

LLNL missions, now and in the future, also demand innovation in data science. Simulations are producing ever-larger data sets, and sensors from diverse sources such as the energy grid, satellites, and laser experiments generate data that requires rapid analysis. We are developing fundamental data science technologies to meet these needs, which will lead to better ways to organize, manage, share, analyze, and act on this data.





CASC transforms applied scientific computing through innovative mathematics, computer, and data science research

Computational mathematics: LLNL's applications demand efficient solution technologies for complex multi-scale, multi-physics systems. CASC researchers meet this need through the development of algorithms and software for solving linear and nonlinear systems, high-order and adaptive discretization technologies for complex computational domains, reduced order modeling techniques, and uncertainty quantification. Our methods are applied to numerous areas of science and engineering, including fluid dynamics, solid mechanics, combustion, elasticity, electromagnetics, large-scale data mining, and cyber security.

High performance computing: LLNL is home to a world-class HPC environment with constantly evolving hardware and a wealth of expertise in porting, running, and tuning large-scale applications. CASC's computer scientists support this ecosystem with research in programming tools to exploit massive parallelism and help developers understand their codes; with resilience technologies that enable complex and long-running applications to deliver results successfully; with power management strategies that help applications use scarce resources effectively; and with investigations of novel memory technologies that move data efficiently through the complex hierarchy of modern storage systems.

Data science: Current and emerging LLNL missions demand innovation in all areas of data science. The nation needs better ways to organize, manage, share, analyze, and act on data being produced by petascale simulations and critical sensors. To meet these needs, we are developing fundamental data science technologies. We are also creating signature applications to specifically address cyber security, electric grid optimization, biodefense, and climate change.

Join our team

CASC hires a wide variety of researchers at many stages of their careers, from student internships and postdoctoral appointments to career staff positions. Current job openings are available at computation.llnl.gov/careers

More information about CASC research projects and software can be found at computation.llnl.gov/casc

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-BR-675038